

AMENDMENTS TO THE CLAIMS

1. (currently amended) A method ~~to disaggregate comprising~~ disaggregating asphaltenes in a petroleum oils and oil mixtures of petroleum oils, feedstream and/or refinery process streams comprising by mild heating of said petroleum oils and mixtures of petroleum oils, feedstream and/or refinery process streams, the disaggregated asphaltenes remaining soluble in the petroleum oil and mixtures of petroleum oils feedstream and/or refinery process streams.

2. (currently amended) The method of claim 1 further comprising the step of determining the presence of asphaltene aggregates by irradiating said petroleum oils and oil mixtures of petroleum oils, feedstream and/or refinery process streams with neutrons and determining small angle neutron scattering (SANS) intensity, I , as a function of wavenumber, q , wherein said scattering intensity includes a coherent component and an incoherent component.

3. (currently amended) The method of claim 2 wherein said neutron scattering wavenumber, q , is in the range $10^{-4} \text{ \AA}^{-1} \leq q \leq 1 \text{ \AA}^{-1}$, ~~preferably $10^{-3} \text{ \AA}^{-1} \leq q \leq 10^{-1} \text{ \AA}^{-1}$.~~

4. (currently amended) A ~~The method of claim 3 wherein to determine~~ The method of claim 3 wherein to determine the regimes of compatibility and incompatibility of petroleum oils and mixtures of petroleum oils and/or refinery process streams are determined using fitting of $I(q)$ in claim 2 to an equation based on a physical model that contains coherent components, ~~contributions a strongly decaying component feature to describe the surface scattering~~ of asphaltene aggregates at the low q ; near its lower range (low- q), a plateau feature component with a rolloff for at higher q near its upper range (high- q) to describe the asphaltene particles, and a constant to describe the high q incoherent scattering component.

5. (currently amended) The method of claim 4 wherein the equation is given by Equation (1):

$$I(q) = I_{\text{incoh}} + I_L / (1 + q^2 \xi^2) + I_{\text{surf}} (q / q_1)^{-\alpha}$$

wherein, I_{incoh} is the constant high- q incoherent scattered neutron intensity, I_L is the low- q plateau intensity of the Lorentzian (second term), ξ is the correlation length (proportional to the radius of gyration of an asphaltene particle), I_{surf} is the low- q value of the intensity due to surface scattering from asphaltene aggregates, α is the absolute value of the logarithmic slope of $I(q)$ at low q , and q_1 is fixed by the lowest q in the range.

6. (currently amended) The method of claim 5 wherein ~~the criterion for~~ incompatibility is determined by the concavity of the low- q plateau intensity of the asphaltene particles, I_L , as a function of the volume fraction of mixing, ϕ_m .

7. (currently amended) The method of claim 5 wherein ~~the criterion for~~ incompatibility is determined by the systematic deviation of I_L , as a function of mixing volume fraction from ~~the a~~ hard sphere prediction ~~given by Equation (2)~~.

8. (currently amended) The method of claim 5 wherein ~~the criterion for~~ incompatibility is determined by ~~the a~~ maximum in the correlation length, ξ ~~given by Equation (2)~~.

9. (currently amended) The method of claim 5 wherein ~~the criterion for~~ incompatibility is determined by the dominance of the low- q value of the surface

scattering intensity, I_{surf} , over the sum of the low- q plateau intensity of the asphaltene particles, I_L , and the incoherent scattering intensity, I_{incoh} .

10. (currently amended) The method of claim 5 wherein ~~the criterion for~~ incompatibility is determined by the power law exponent, α , exceeding a value of three.

11. (currently amended) A method to estimate the volume fraction of asphaltene aggregates, ϕ_{agg} , in incompatible petroleum oil and/or refinery process stream mixtures based on ~~comprising determining the~~ a difference between I_L , the low- q plateau intensity corresponding to the asphaltene particles, I_L , ~~determined in claim 5 at different volume fractions of mixing, ϕ_m , and a prediction for the behavior of this I_{HS} , the intensity expected for spherical particles interacting by contact repulsions perfect hard spheres in the absence of aggregation, wherein I_L and I_{HS} are determined at different volume fractions of mixing ϕ_m .~~

12. (currently amended) The method of claim 11 wherein the equation to estimate the volume fraction of asphaltene aggregates, ϕ_{agg} , is given by Equations (2) and (3) the difference between the measured value of $I_L(\phi_m)$ and the $I_L(\phi_m)$ for perfect hard spheres in the absence of aggregation.

13. (currently amended) The method of claim 2 5 wherein the total surface area of asphaltene aggregates per unit volume of the petroleum oil, S_V , is determined from the ~~amplitude of the~~ surface scattering intensity, I_{surf} , ~~from asphaltene aggregates at low wavenumbers, q .~~

14. (currently amended) The method of claims 12 ~~and 13~~ wherein the average length scale, R , associated with the internal structures of the asphaltene

aggregates is estimated using Equation (4) determined from the ratio of the volume fraction of asphaltene aggregates and the total surface area of asphaltene aggregates, wherein the total surface of asphaltene aggregates per unit volume of the petroleum oil, S_V is determined from the surface scattering intensity, I_{surf} at low wavenumbers, q .

15. (New) The method of claim 2 wherein said neutron scattering wavenumber, q , is in the range $10^{-3} \text{ \AA}^{-1} \leq q \leq 10^{-1} \text{ \AA}^{-1}$.

16. (New) The method of claim 1 wherein said heating is performed at a temperature between 40°C and 150°C for a time period of 1 minute to four weeks.

17. (New) The method of claim 1 wherein said heating is performed at a temperature range between 40°C and 100°C for a time period of 2 minutes to 24 hours.

18. (New) The method of claim 1 wherein said heating is performed at a temperature range between 40°C and 80°C for a time period of 3 minutes to 3 hours.

19. (New) The method of claim 1 wherein said heating is performed at a temperature range between 40°C and 60°C for a time period of 4 minutes to 1 hour.